



IMPACT OF THE EXTRACTION OF INERT MATERIALS FROM RIVERBEDS ON ECOLOGICAL BALANCE

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ABSTRACT

Extraction and production of inert materials from riverbeds has recently resulted in some serious environmental problems. This is because river beds are exploited by quarries without considering the specific features and material resources of rivers, material carrying capacity of rivers, chemical and mineralogical composition of inert materials and the related impacts made on the environment. Scientific and practical findings of monitoring works, conducted in sand and gravel quarries of river beds present in the territory of Azerbaijan, indicate that unregulated exploitation of quarries violates ecological balance, which in turn causes a number of problems. Solution of these problems requires thorough investigating, based on which influential measures should be undertaken.

KEY WORDS: riverbed, inert, engineering and geological, infrastructure, ecological balance, sand, gravel, physical-mechanical, mineralogical, chemical, petrographic.

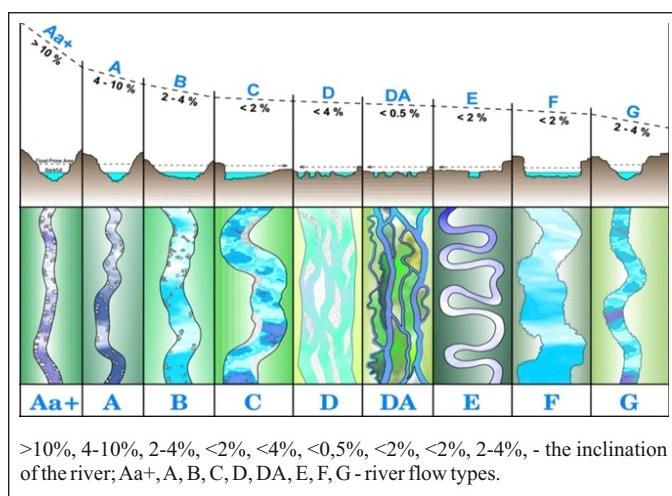
INTRODUCTION:

Development of a society inevitably must go based on interaction with the nature, since natural resources are used intensively in order to meet demands of humans, as well as provide economic and social development.

Changes in the nature, caused by anthropogenic impact mostly have a positive character. However, unwise intervening to natural processes violates some of the natural regularities and contributes to unwanted conditions that can happen in the future. In modern times, one of the most serious threats to the existence of mankind is the pollution of the environment and the depletion of natural resources. In this regard, eliminating the environmental crisis currently available makes necessary to protect the environment and use natural resources in an efficient manner.

1. Exploring specific features of rivers usable in quarry businesses, study of material resources and quality indicators:

It is important to take into account the specific features of rivers with respect to developing quarry activities on river beds. Rivers in Azerbaijan may have self-recovering capacity with respect to their material resources and also may lack such feature. From this view, particular attention should be paid to the specific features of the rivers (Picture 1).



Picture 1: Specific features of rivers

One of the most important requirements in managing quarry activities is related to quantitative and qualitative indicators of a material, intended for extraction. Since the second half of the last century, engineering and exploration works were carried out by geologists, who launched exploration of sand and gravel resources as well. Currently, this field is supervised by the Mineral Resources Agency of the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan.

Large-scale construction works in the country is conducted in complex engi-

neering and geological conditions. Given the fact that construction and installation works are widely conducted in Baku, it is not difficult to understand that needs for sand and gravel deposits are satisfied at the expense of the inert materials transported to the area from other regions of the country since such reserves of industrial scale and importance are not found around the capital city. Approximately 80% of those inert materials are extracted from riverbeds. This process causes degradation of landscapes and infrastructure of riverbeds and surrounding areas, having negative impact on the ecological balance, whereas large amount of funds are needed for related rehabilitation works.

On the other hand, sand and gravel materials extracted from river beds are supplied for use in the construction sector without any testing and careful exploring of chemical-mineralogical composition, physical and mechanical properties of those materials compliant to the requirements of the norms and rules (AZS 473 - 2011 (GOST 8267-93)). Thus, various mountain rocks produced by quarries typically are sent directly to concrete, reinforced concrete and asphalt concrete plants without exploring their composition. It is feasible that concrete mixtures supplied for construction facilities may contain some components that may adversely affect the durability of the concrete, used in construction and installation works, depending on the various conditions, and even may lead to destruction of microstructure of a used material. Therefore, the chemical-mineralogical as well as physical-mineralogical features of inert materials produced by quarries must be explored. It concerns strength, radioactivity, material and petrographic composition, reactivity capability and other properties of materials.

2. Violation of ecological balance in rivers due to incompliance of sand-and gravel extraction with the norms and rules:

The carried studies found that the sustainability of riverbeds towards erosional impact of water flow has been drastically diminished alongwith the rivers present in the country (Tartarchay, Goychay, Lankaranchay, Valalachay, Garachay, etc.) due to long operations led in sand-gravel quarries. Meantime, activation of riverbed deformations is observed, while riverbed processes have been shifted from accumulative regime to erosion regime.

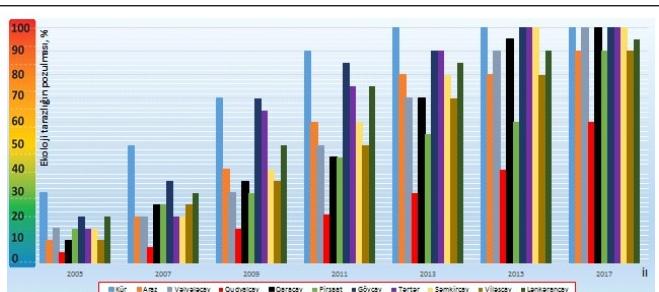
Depending on the erosion processes going in the riverbed, the values of depth deformations vary as much as 3–10 m, and the mean value of the fall of depth of river bed is more than 6 m (falling more than 5 m is regarded as a hazardous state of riverbed deformation). The volume of riverbed clay and clayey rocks entering from the Terter River to the Kura River as a result of riverbed deformations make up 12 million m³. The value of the deformations in the Tartar River varies from 50 to 200 m, and the average figure is 150 m.

Typically, that the sand and gravel mass excavated from the riverbeds exceeds the hard mass, accumulated by the water stream. This factor results in a decrease in the level of river beds, a relative increase in the speed of water flow, and intensification of the bottom and lateral erosion processes. This is followed by anthropogenic impacts on different technical installations located in those areas and deterioration of local environmental situation. The scale of these effects continues to grow.

The observations conducted by us discovered that the fall of level of riverbeds and related intensification of erosion processes occur even without the impact of sand- and gravel quarries. As a result, the strength, speed and scale of the erosion process vary naturally, depending on the morphological and hydrogeological characteristics of the regions. In the northern and western parts of the country, the restoring capacity of rivers is weak, whereas in the north-western part, in quite opposite, the rise in level of riverbed is observed.

In the area between Ismayilli and Balakan districts that cover the southern foothills of the Greater Caucasus Mountains, large sand and gravel deposits of construction importance are available. The mountain rivers (Akhokhchay, Dashagilchay, Kishchay, Katekhchay, etc.) forming these deposits, have strong restoring capacity enabling them to continually increase reserves of sand and gravel deposits available in their beds. It is observed that gradual rise in level of beds take place not only in accumulation zones of these rivers but also in transit zones. Eventually, foots of bridges and other hydrotechnical installations and the adjacent areas are covered with sand and gravel materials as well. These rivers should be regularly examined with considering the accepted rules.

Studies show that there is an unobvious irregularity in the establishment of quarries in the territory of the country. Improperly managed extraction carried in these quarries has had negative ecological consequences, as a result of which, the level of riverbeds has been decreased, and erosion processes have been intensified. Operation of quarries in riverbeds has had negative impact on protective dams, irrigation systems, bridges and hydrotechnical structures. Arable lands have become almost non-useable.



Picture 2: Violation of the ecological balance of rivers due to unregulated operation of sand and gravel quarries.

3. Evaluation of damage caused to the infrastructure from operation of sand- and gravel quarries, when the operation standards and rules are not followed:

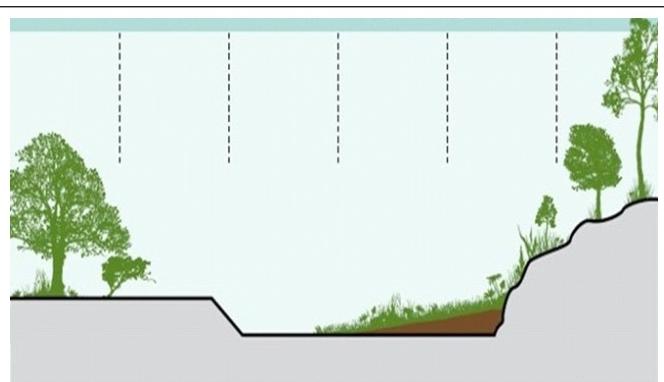
Because of operation of quarries, negative impact has been posed to residential buildings, bank protecting installations, motorway and railway bridges, canal installations with culverts, high voltage power lines, gas pipes, plantations and pastures, gardens and forestry facilities. In this regard, there is a need in carrying relevant researches on feasible hazards posed by quarries, as well as undertaking additional urgent measures to protect the population and territories from floods.

The main focus in the research was over the bridges, hydrotechnical installations, high-voltage power lines, water-, oil- and gas pipelines of strategic importance, lands affected by heavy erosion processes, riverbeds with poor self-restoring capacity etc., situated close to extraction process led by quarries.

The carried observations also revealed that one of factors contributing to deterioration of ecological situation is related to the lack of waste management facilities of mining companies, and also lack of land restoration (leveling) works (Picture 4). Thus, many quarries, including those ones operating with sandblocking equipment have largely dumped wastes containing gravel into riverbeds in the form of tall puddles which used to entail change in their relief. Exploitation works have left deep uncovered and unleveled pits, cliffs and hills in various riverbed areas that are the sources of hazard with respect to movement of domestic animals and even humans during the night time (The Gazanbulag village of Goranboy district, as well as basins of Goychay, Valvalachay, Garachay, Terterchay and other rivers). It has been found that in most cases no restoration works have been implemented either following the excavation of fertile soil layer or during conservation and post-extraction phases (Figure 3).



Picture 3: Violation of the ecological balance related to lack of land restoration (leveling) in sand and gravel quarries



Picture 4: Restoration and reclamation of riverbeds after the completion of extraction period at sand and gravel quarries.

CONCLUSION:

- Construction sector is provided with sand and gravel materials extracted from river beds without any assessing of their chemical and mineralogical composition and also physical and mechanical properties. It happens in condition of incompliance with standards and rules and technological regulations as well. This factor adversely affects the longevity and efficiency of the concrete used in various conditions, and also damages the microstructure of concrete structures.
- Taking into consideration the violation of the ecological balance in the rivers driven by the unregulated operation of sand and gravel quarries, the monitoring of rivers running in the territory of the country has been conducted. The reasons and the results of this violation have been investigated on a scientific basis. As a result, the comparative analyses carried out by 11 rivers show that depending on the individual features of some rivers, there are disproportions between the materials taken from the riverbeds and the materials accumulated by water stream because of poor restorative characteristics of the rivers. Ecological balance has been violated as riverbeds has become unfavorably expanded, caused by the excessive extraction of materials (Pictures 1 and 2).
- Absence of waste storing facilities of mining companies and lack of reclamation (leveling of the surface) are the factors adversely affecting the ecological situation (Picture 3). It is advisable to carry out reclamation in accordance with the valid rules for to eliminate these gaps (Picture 4).

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